Call for Participants

The Molecular Sculpture Project

Philip Ball

> *The human being, a chemist, chooses the molecule to be made and a distinct way to make it. The situation is not all that different from the artist who, constrained by the physics of pigment and canvas, and shaped by his or her training, nevertheless creates the new.* (Roald Hoffmann)

> *If we had those [molecular] tweezers (and it's possible that, one day, we will), we would have managed to create some lovely things that so far only the Almighty has made, for example, to assemble – perhaps not a frog or a dragonfly – but at least a microbe or the spore of a mold.* (Primo Levi)

> *To chemistry, the skies are wide open, for if it is a science, it is also an art. By the beauty of its objects, of course, but also in its very essence, by its ability to invent the future and to endlessly recreate itself… Like the artist, the chemist engraves into matter the products of creative imagination. The stone, the sounds, the words do not contain the works that the sculptor, the composer, the writer express from them. Similarly, the chemist creates original molecules… that did not exist before they were shaped at the hands of the chemist, like matter is shaped by the hand of the artist.* (Jean-Marie Lehn)

It will seem perhaps to be a strange notion, to non-chemists, that chemistry has an aesthetic. But it does. Chemists often make molecules that are admired not for their utility or ingenuity but for their artistry. These molecules are perceived to be beautiful. That is, sometimes, the sole reason for their creation.

Every kind of sculpture has its own techniques. There are methods for putting together objects made from metals, from wood, from clay or plastics or fabrics. They are typically rather specialized methods and may demand a high degree of technical skill. The art of the conception must merge with the craft of the production. Chemistry is no different. There are highly sophisticated techniques for putting molecules together to create particular shapes and arrangements and patterns.

But chemistry is not normally regarded as one of the plastic arts. This project invites us to do so. It will display objects of molecular sculpture that have been created both because their makers consider them beautiful or striking or remarkable and because they show how molecular chemistry can be used to stimulate the same kind of questions that art has always raised: how we perceive and relate to the world around us, how we communicate ideas, how we develop visual languages.

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These questions do not depend on idle analogies. They are perfectly concrete, and they pertain immediately to dilemmas faced by contemporary artists. When, as often happens, a chemist decides to make a molecule, using the techniques of chemical synthesis, purely because it has a shape or form or property that he or she finds pleasing (and not because there is any potential application for it), the chemist must then ask how this creation can be displayed to others. That is not so hard to arrange for the normal target audience: the synthesis is described in a scientific journal, complete with schematic diagrams of the molecular structure and graphical plots of measurements made to verify that the molecule has the shape claimed for it. That is enough.

But suppose the chemist has a broader purpose in mind. Suppose he or she wishes to show this object to a non-scientific audience. Those graphs will mean nothing. Those diagrams are just schematic sketches, like a Titian painting rendered as stick figures. How can the molecule itself be shown?

A computer model? A three-dimensional shape-filling model? These are not *the work*, they are representations of it, as though that Titian painting were to be reproduced as a photo of people wearing the right clothes and adopting the right postures. An electron micrograph, then, if the molecule is big and robust enough – or failing that, an image taken with a scanning tunneling microscope or some such. Where is the beauty then in these fuzzy blobs, draped in false color? And are these in any case not mere photos of the sculpture itself?

The sculpture is real; it is a physical object. But it can never be seen. This is true not just in practice but in principle. We cannot see it. Light will not reveal its outlines and shadows. And any other method of visualization is indirect – it must be converted to an image that we can interpret with our own eyes.

How, then, does one communicate the invisible? How does the chemist share his or her aesthetic experience of the molecule (which is real and can be very strong) with someone who does not know how to make sense of the means of expression conventionally used?

This same problem is faced by an artist such as Richard Long, who has made works of art from walks through the countryside. Long might choose to record that experience as a series of photographs, or as a line drawn on a map. None of these things is the 'work'. They are ways of representing the work. They do not provide the viewer with the experience that Long had on the journey itself. They are quite literally the map and not the terrain.

For Long, this disjunction between the primary experience and the recording or transmission of it is part of the point. These accoutrements, these diagrams and snapshots and scribbled notes, are ways of speaking about an event that only he experienced. The art resides in the communication. Long does not tell us simply to go and retrace his footsteps. That might be interesting, but it does not carry the same message about the artist's struggle to be understood. It would not force us to work as hard, to become a part of the very process of creation as we put together imagined sights and sounds and senses from a series of suggestive clues.

Isn't this just what chemists are compelled to do in presenting the objects they have made? The Molecular Sculpture project will provide its audience with various kinds of clue about the objects it has created, and the viewers will put these together and see what they can find.

British artist Mark Quinn raises related issues in his portrait of Sir John Sulston: a photograph of the chromatograph of Sulston's DNA. Is this Sulston's 'image'? It gives potentially more information than a painting ever could, yet we can't recognize it. It asks to what extent Sulston *is* his genes, and to what extent he is other things. And it asks, perhaps unwittingly, how one should depict DNA, the molecule. There are many ways in which one could do so – this is not a unique portrait. Quinn runs into the very issue that this project highlights explicitly: seeing the unseeable.

In the normal course of events within scientific research, this 'problem' of seeing does not matter very much. Many synthetic molecules are tremendous feats of atom-engineering, and they may have a certain charm, but they are not generally considered to be objects worthy of artistic attention. So no one feels a need to think too hard about the challenge of how to display them – balls and sticks will do. I propose that the participants in this project will make molecules that are worthy of closer consideration.

Thus I am seeking proposals from chemists for targets in molecular synthesis that raise interesting and challenging ideas when viewed as objects of sculptural art. They could be single molecules or multi-molecular assemblies. They need not be difficult to synthesize; the point is not to expand the boundaries of synthesis (although there is no harm in that!). They do not even necessarily need to be entities that have not been synthesized before (although I expect that they will be). They might be witty; they might be beautiful. Some illustrative ideas that come to mind are:

- 'Chinese lantern' *chochin* cyclophanes that glow via the encapsulation of a luminescent ion
- 'gold crowns': Au-binding crown thioesters
- molecules with complex topological properties
- a 'molecular garden' of dendrimers and dendrons tethered to a patterned substrate
- examples of protein engineering that challenge our notions of how we function
- 'alternative biologies' suggested by, *e.g.* right-handed DNA – c.f. Roald Hoffmann: "The nucleic-acid system that operates in terrestrial life is optimized (through evolution) chemistry incarnate. Why not use it… to allow human beings to sculpt something new, perhaps beautiful…"
- encapsulated or bound radionuclides, random decay of which creates slowly evolving patterns
- molecules that offer new ways of looking at iconic or familiar objects – c.f. the photographic images by British artist Cornelia Parker.

These may be trivial compared with the ideas this proposal might elicit. (I rather hope they are!) They are certainly not intended to be prescriptive.

These synthetic targets will be represented in a wide range of ways. Spectroscopic plots, mass spectrographs, diffraction patterns, micrographs, as well as crystals or solutions themselves – all will be valid ways of 'displaying' the objects, and will be properly mounted and presented. Molecular models (either physical or virtual) need not be ruled out, but we must bear in mind that these are not, within this context, illustrations of what the molecules 'really' look like (which is how chemists typically regard them) but are merely idealized schematizations of the 'object' itself. In this regard, sketches and lab notebooks will be equally valid (and perhaps more revealing) ways of showing both the artistic process and the artist's means of conveying the message of the work.

I emphasize again that the aim of this project is not pedagogical (although it is likely that the result will have some pedagogical value). It is not to explain what chemistry is by refracting it through an unusual prism. Rather, it is to pose the question of whether there is indeed a genuine form of sculpture at the molecular scale, and what that might imply for the way works of art are perceived.

It is anticipated that the project will encompass perhaps ten or so 'objects', each prepared by a different group. The results will be displayed in arenas that will reach audiences whose interests are both scientific and artistic. I hope and anticipate that they will promote a new kind of discussion about how the two endeavors are related.

I would strongly recommend that potential participants take a look at *Hyle* **9**(1) (March 2003), a special issue on Aesthetics and Visualization in Chemistry. In particular, the article 'Aesthetics of Chemical Products' by Joachim Schummer brings into focus many of the issues with which this project is concerned. Schummer's critique of the common identification of 'molecular beauty' with a high degree of symmetry illustrates one of the pitfalls that I hope to avoid. At the same time, Schummer's contention that the invisible and in some degree insensible nature of molecules removes them from the realm of any conventional aesthetic criteria formulates precisely the issue that I hope here to confront.

Funding will be sought, pending a sufficient response from prospective participants; and suggestions of funding sources are welcomed! The material costs of the project are unlikely to be high; the question is really whether you feel able and willing to invest the necessary time and imagination.

If you would like to take part, please reply to:

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